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MacKenzie et al.

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(54) **METHOD OF MIXING GASES FOR A GAS CUTTING TORCH**

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Related U.S. Application Data

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F23D 14/82 (2006.01)

(52) **U.S. Cl.**
USPC **148/196**; 266/48

(58) **Field of Classification Search**
USPC 148/194, 196; 266/48; 239/419.3
See application file for complete search history.

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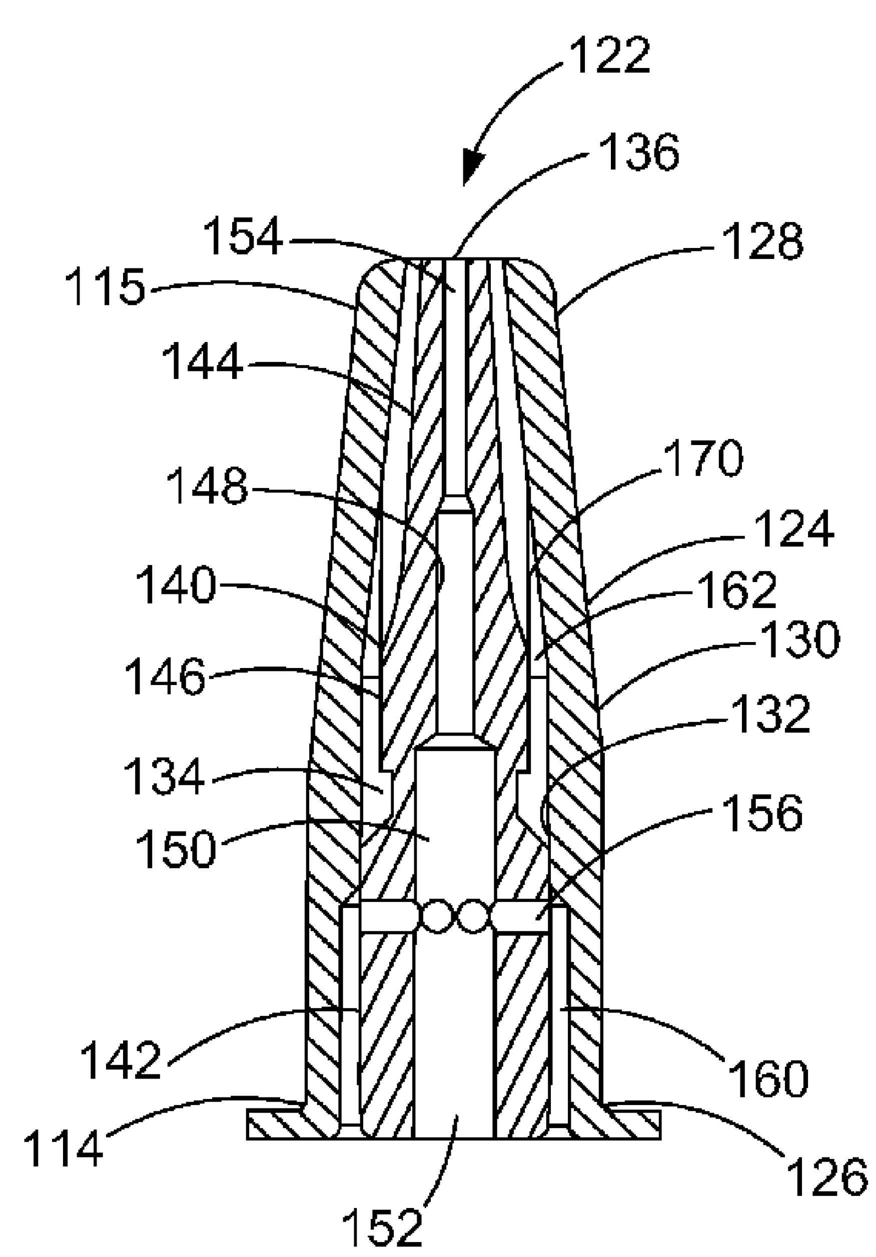
(57) **ABSTRACT**

A method of directing gas flows in a gas torch includes directing a flow of a first gas and a flow of a second gas to a mixer central gas passageway of a mixer and directing the flow of the mixed first and second gases from the mixer to an axial passageway of a tip. The method further includes directing a flow of a third gas to an outer passageway of the tip, directing the flow of the third gas inwardly through at least one intermediate gas passageway, and then directing the flow of the third gas to a tip central gas passageway of the tip. Finally, the flow of the mixed first and second gases and the flow of the third gas are directed distally through a distal portion of the tip.

20 Claims, 8 Drawing Sheets



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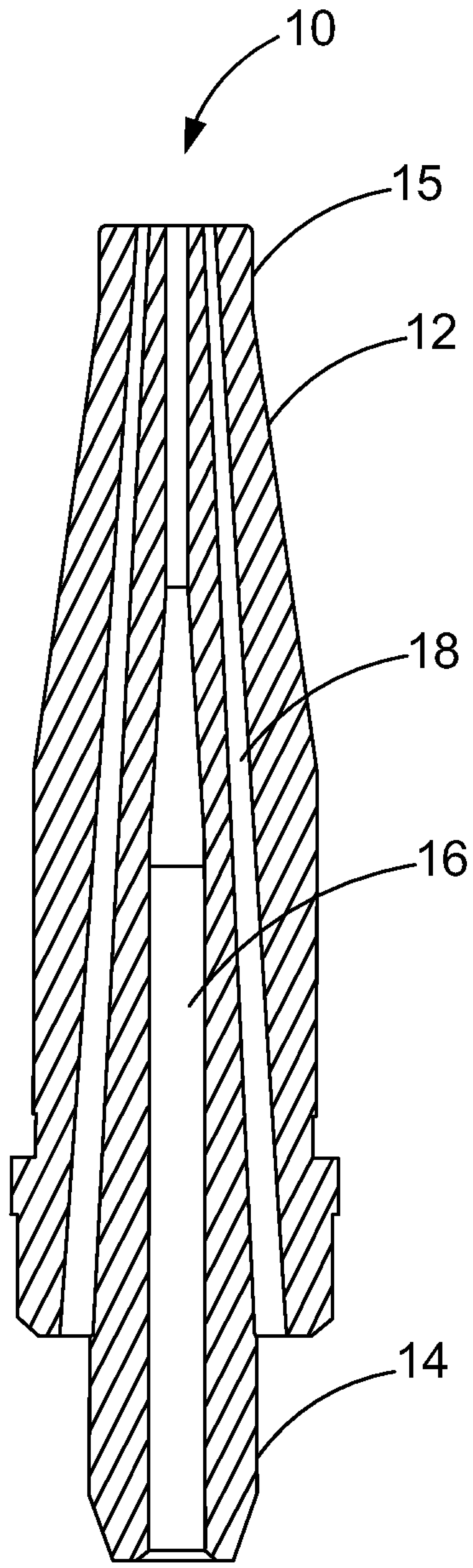

Fig. 1a
(prior art)

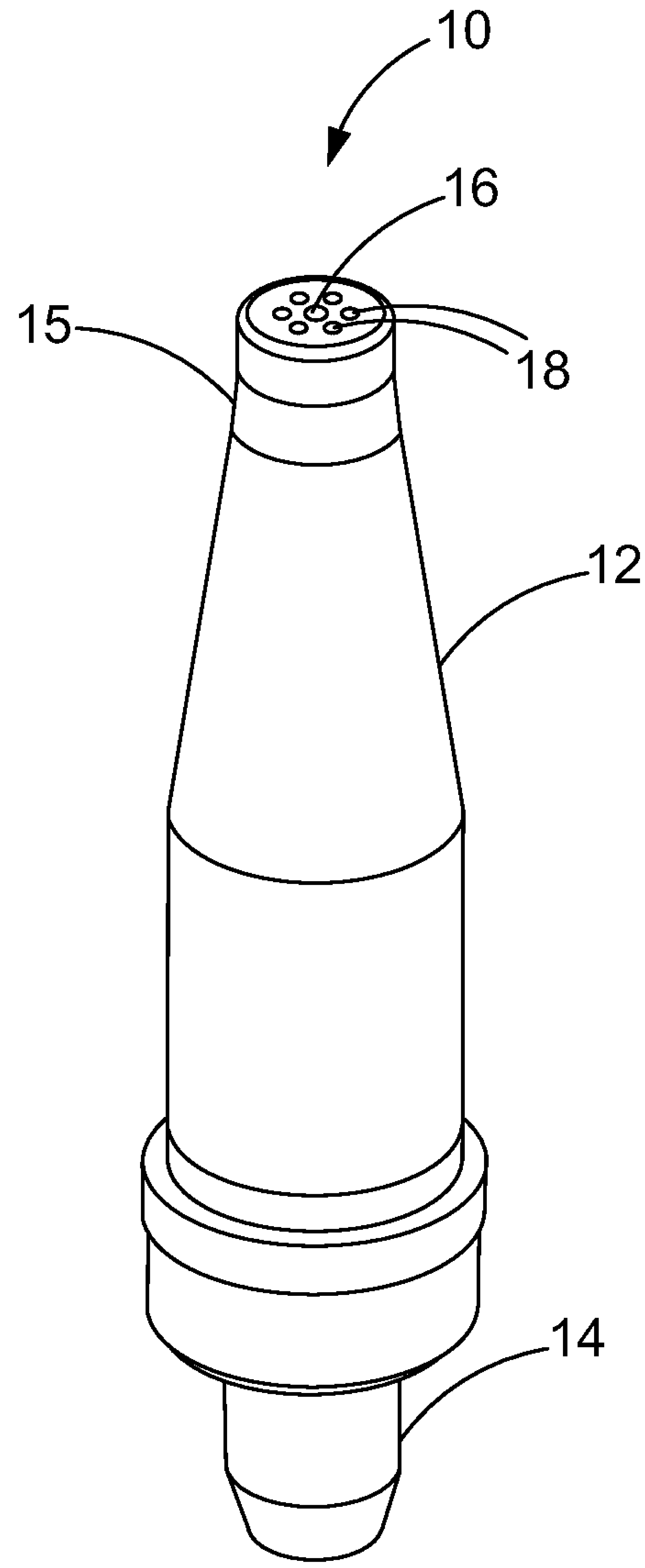

Fig. 1b
(prior art)

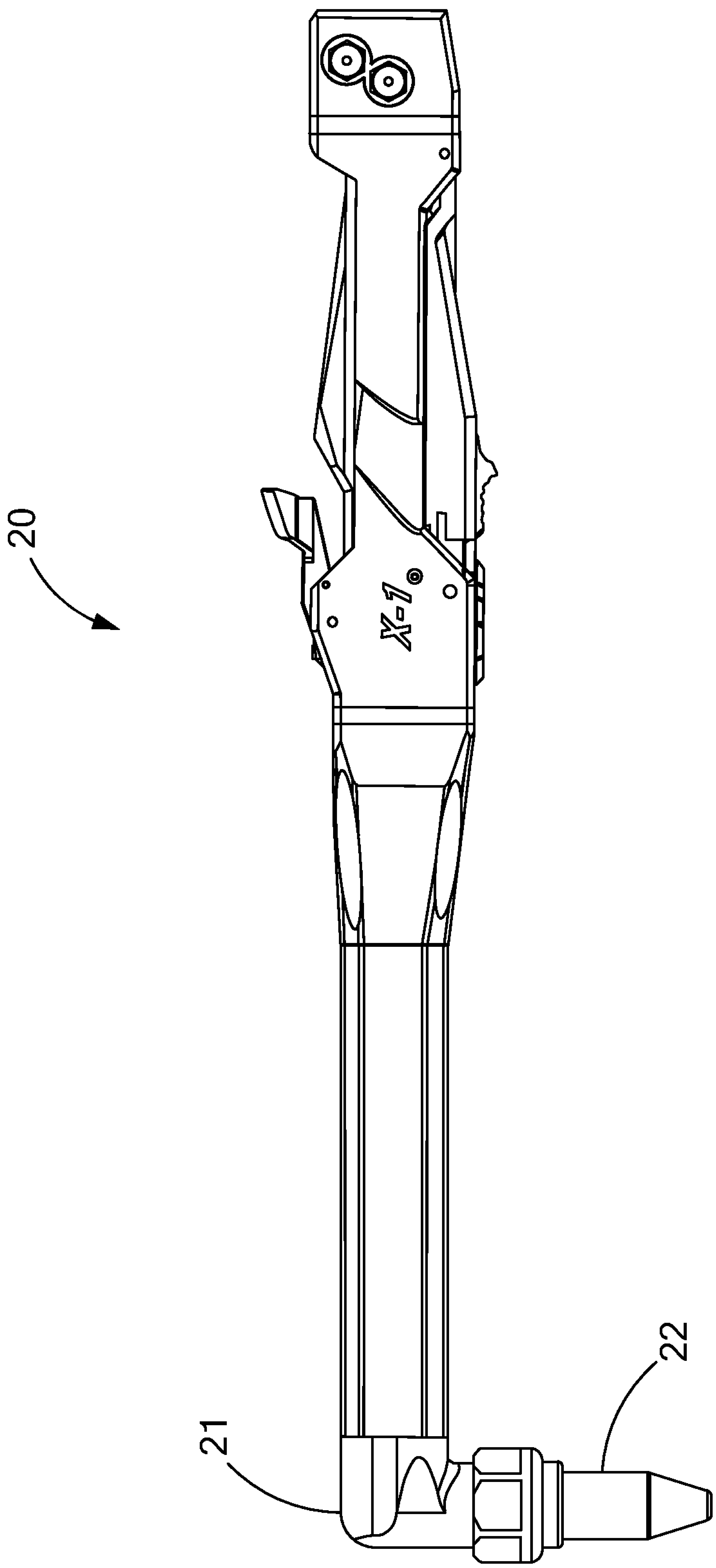

Fig. 2

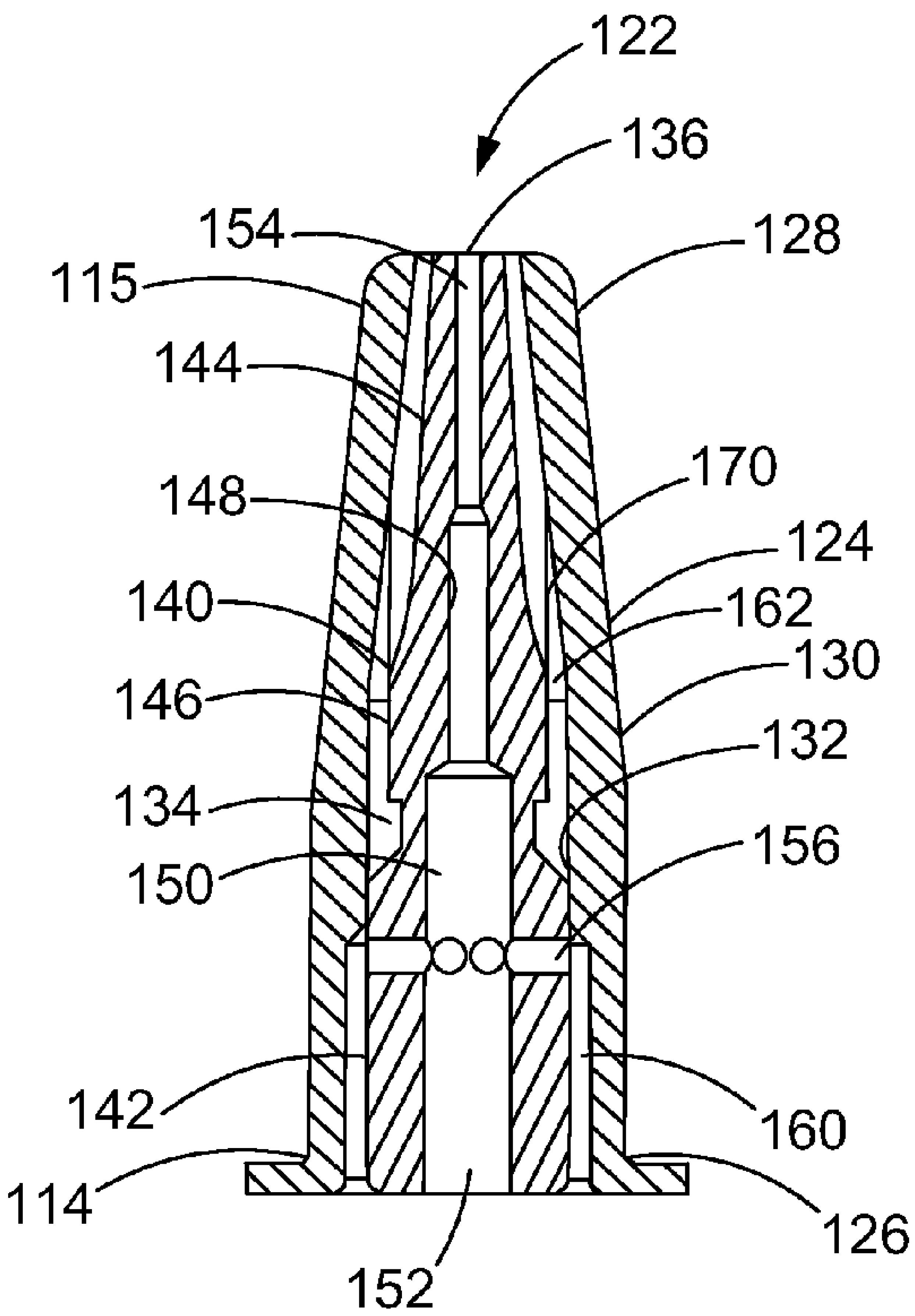

Fig. 3a

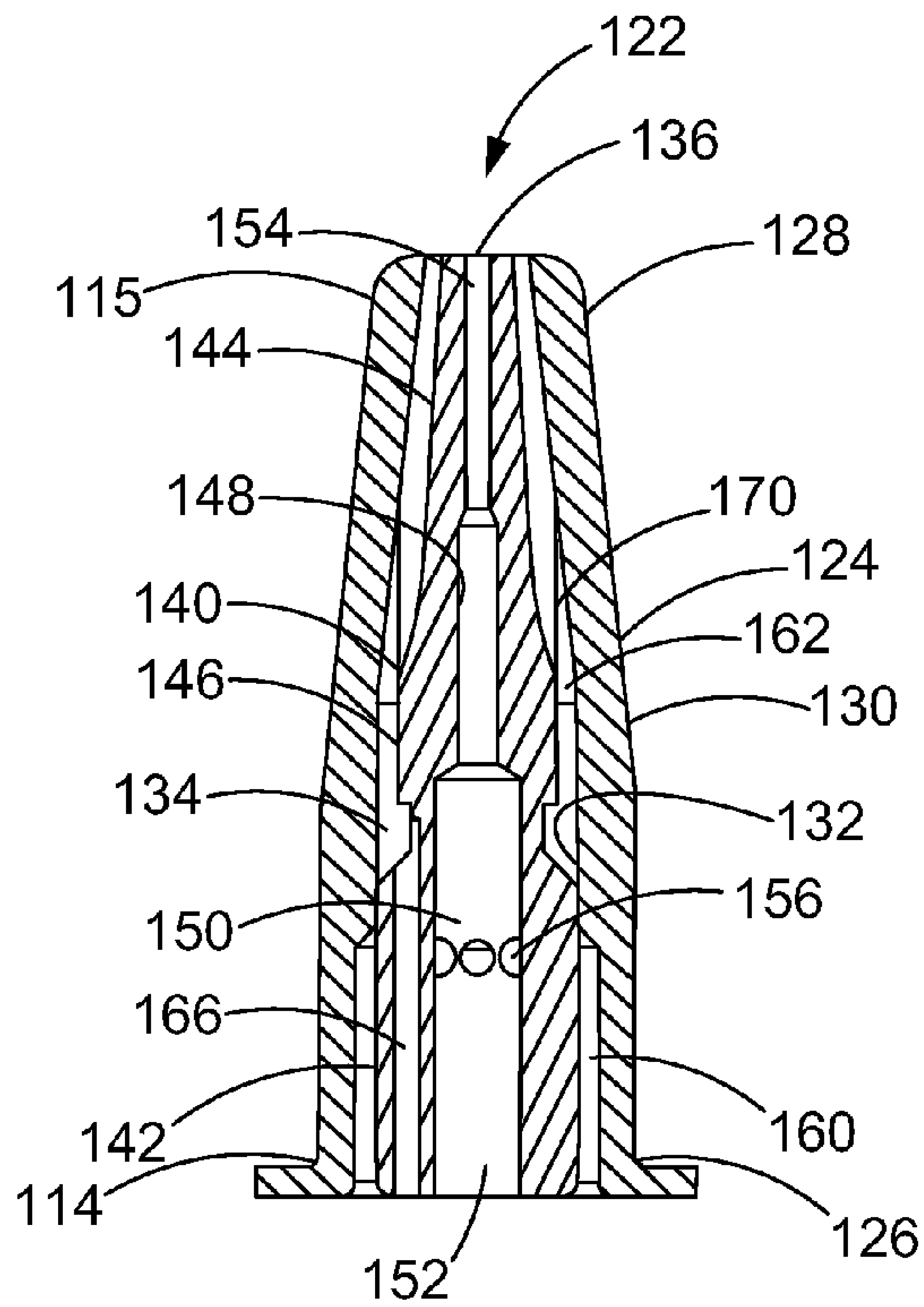

Fig. 3b

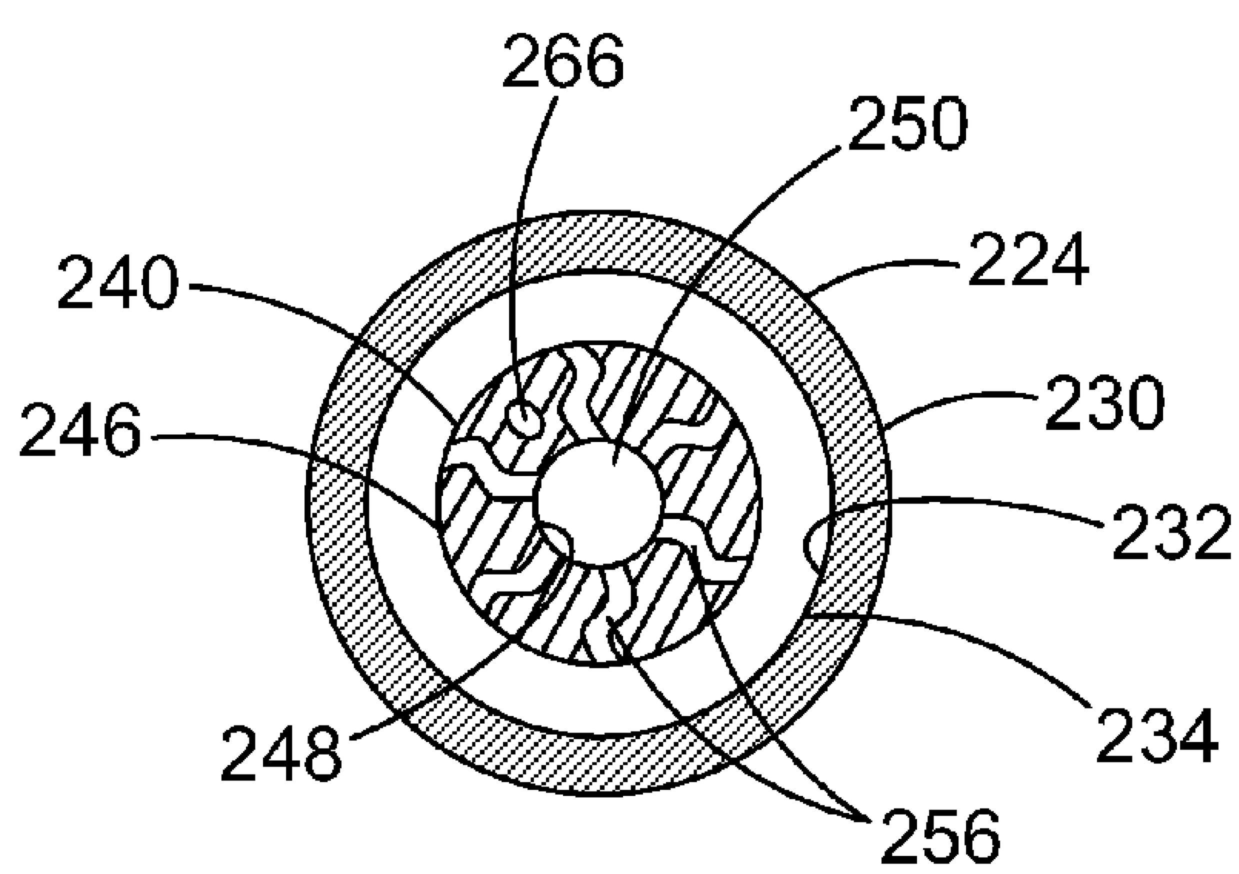

Fig. 4

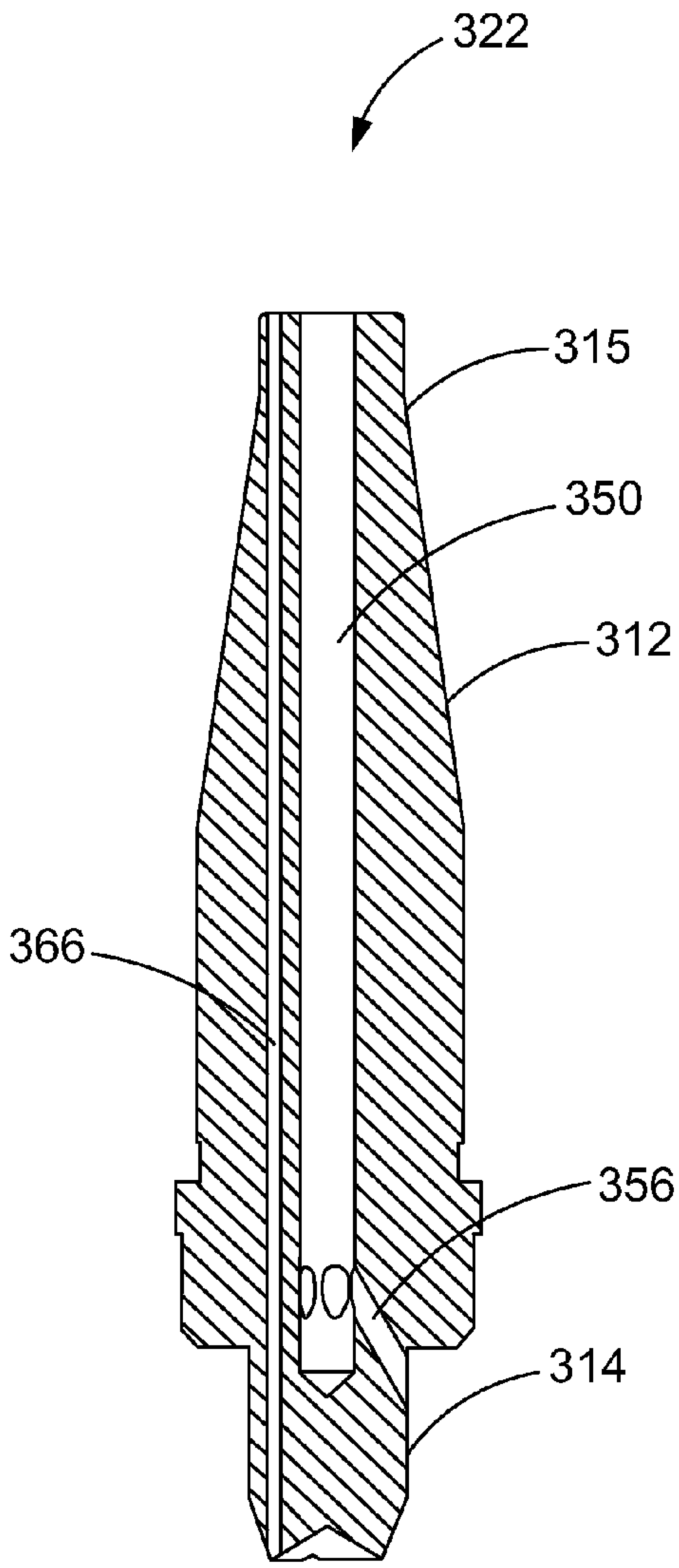

Fig. 5a

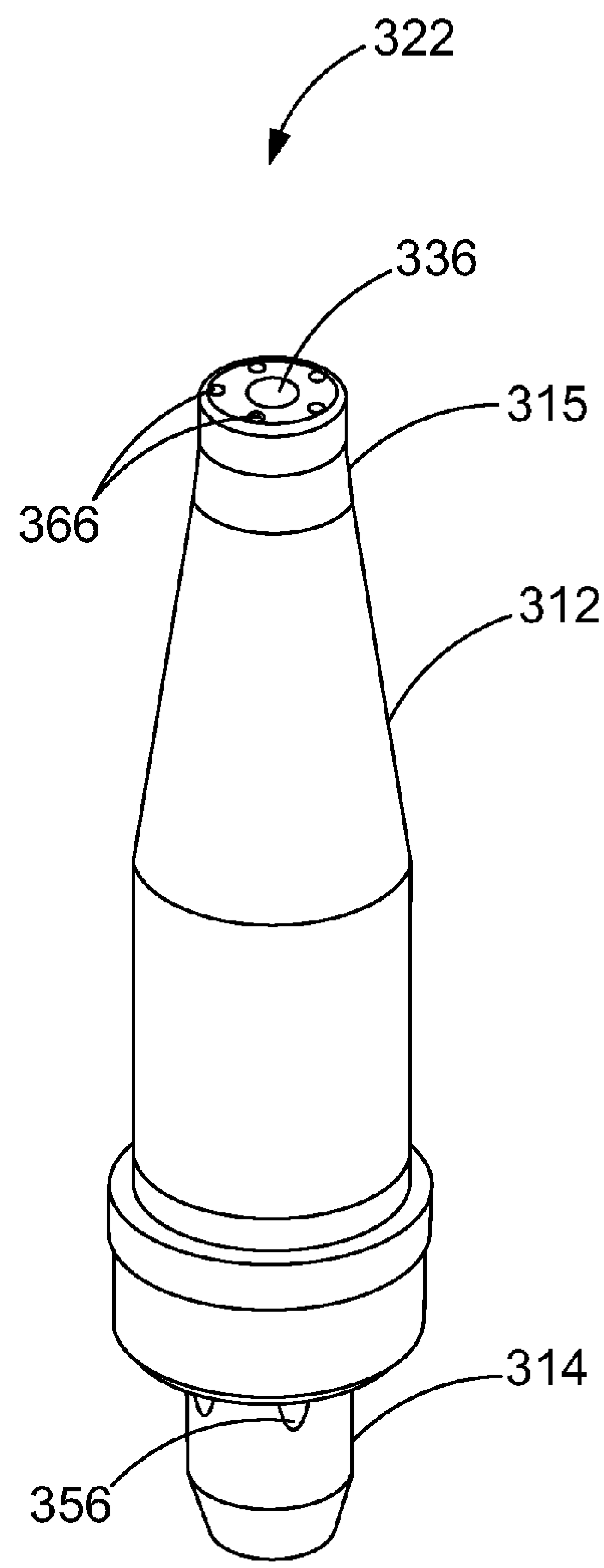

Fig. 5b

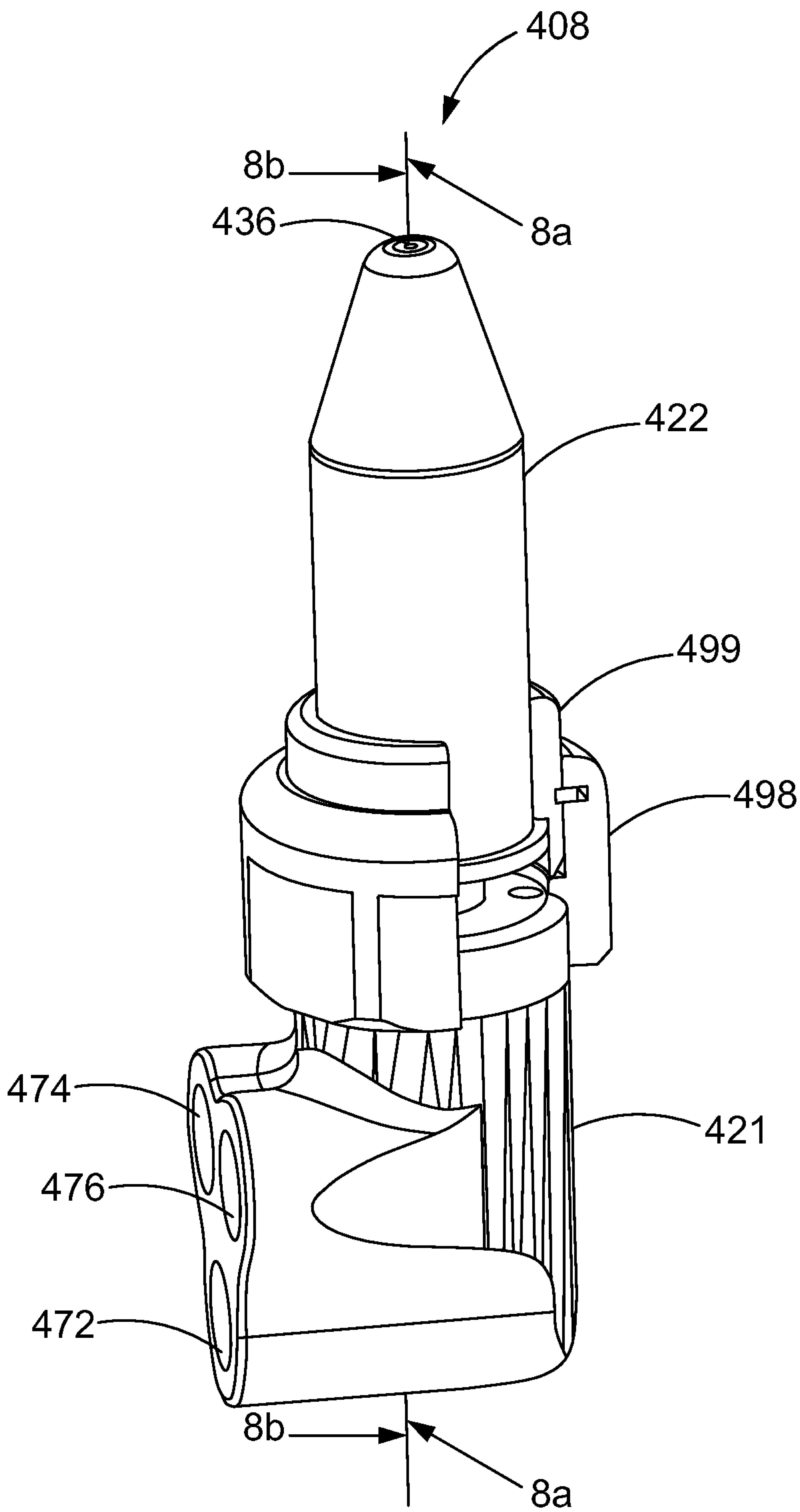

Fig. 6

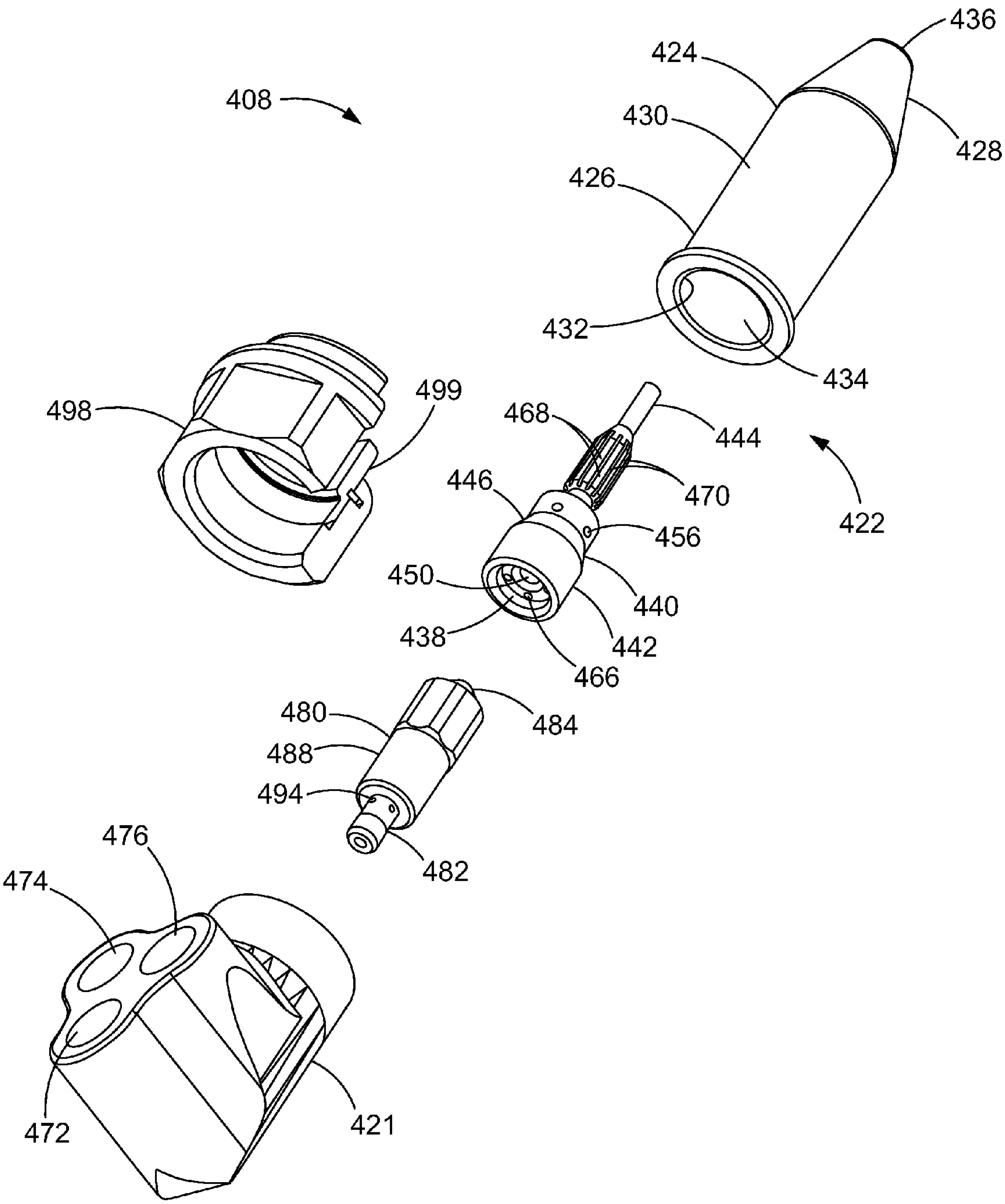
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Fig. 7

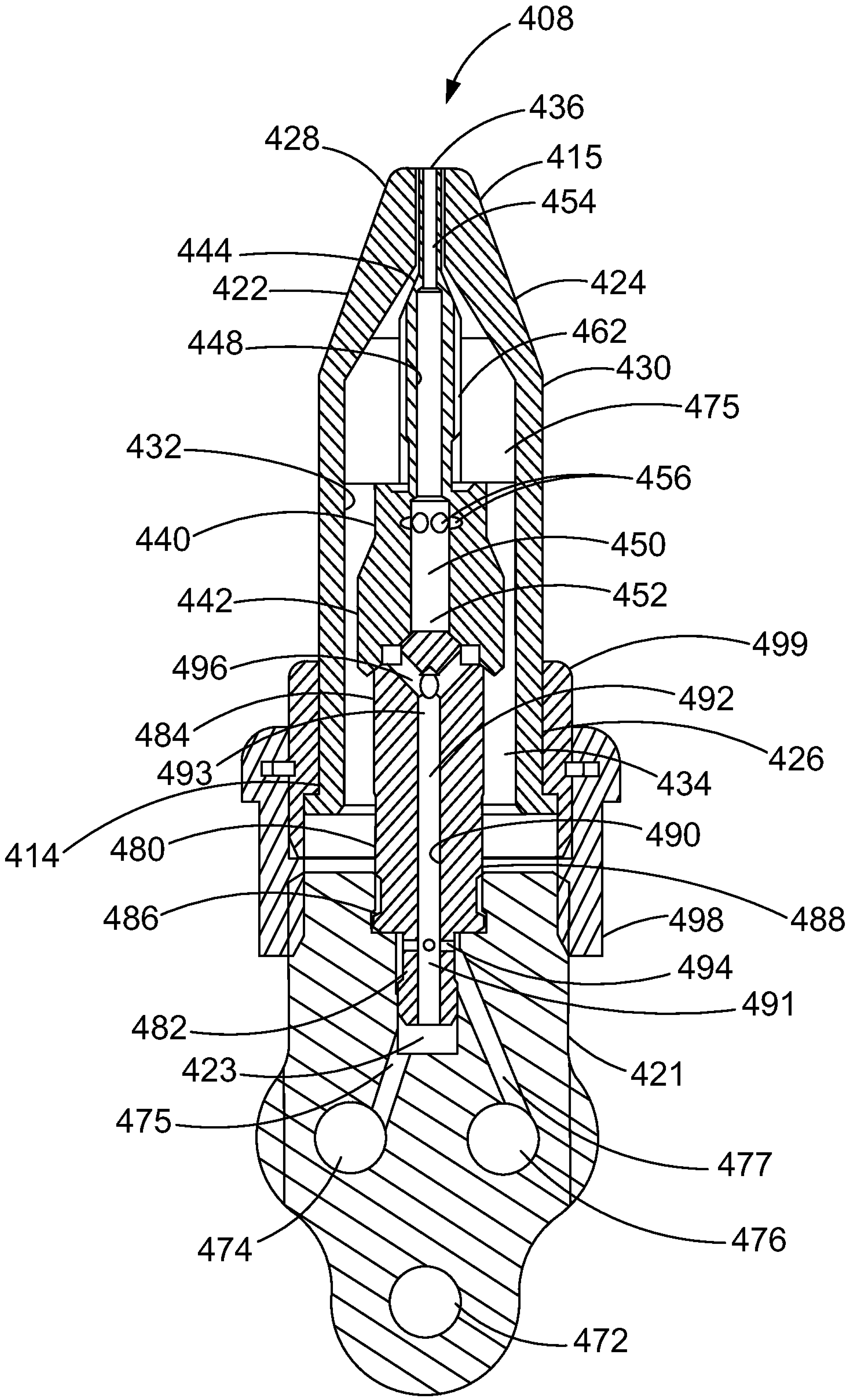
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Fig. 8a

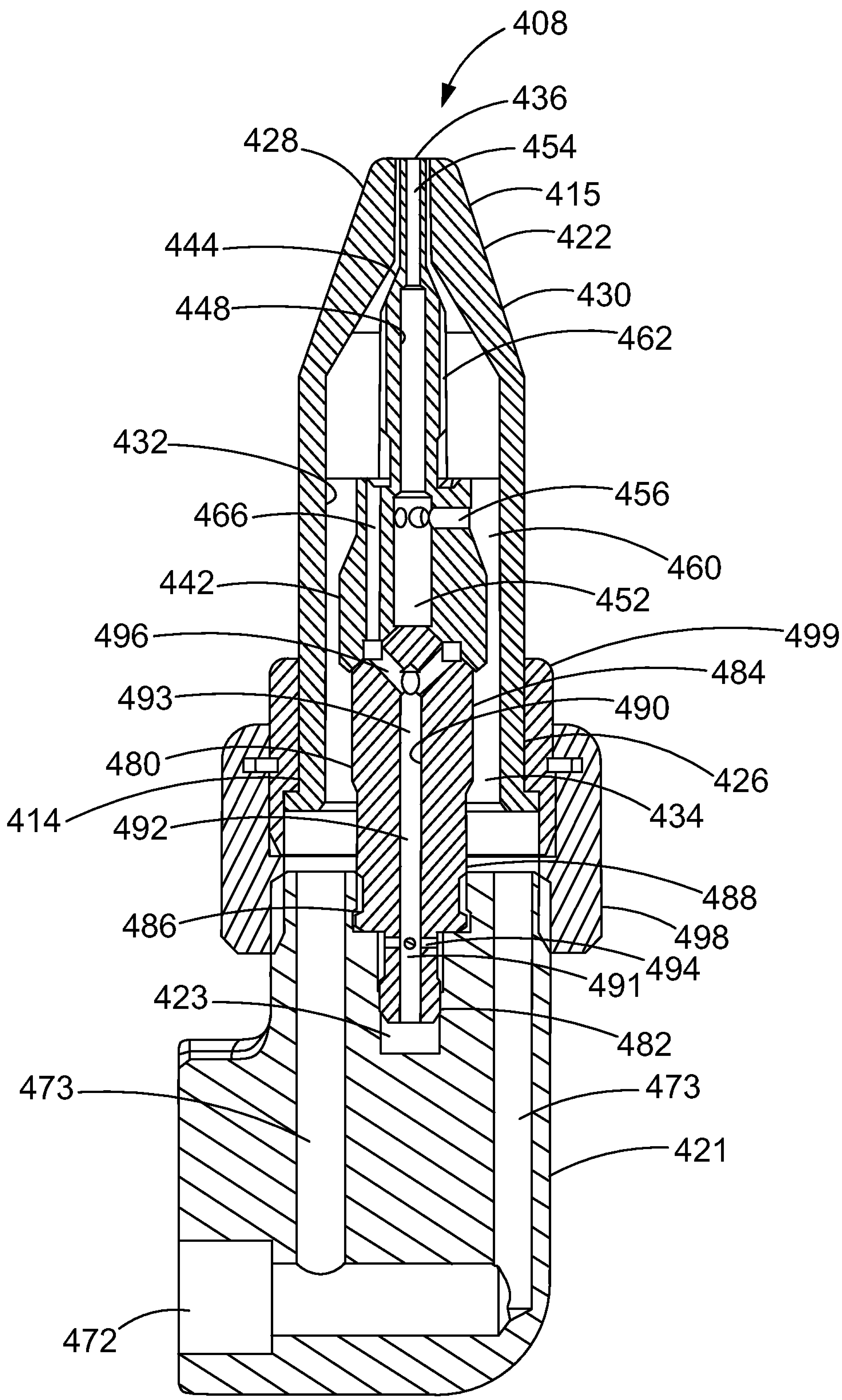
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Fig. 8b

METHOD OF MIXING GASES FOR A GAS CUTTING TORCH

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is a divisional of and claims the benefit of U.S. application Ser. No. 12/849,030, filed on Aug. 3, 2010 and titled "IMPROVED MIXER FOR A GAS CUTTING TORCH," which is now issued U.S. Pat. No. 8,568,651, issued Oct. 29, 2013, the content of which is incorporated herein by reference in its entirety.

FIELD

The present disclosure relates generally to a gas cutting torch and more particularly to a tip assembly of a gas cutting torch having an improved mixer.

BACKGROUND

The statements in this section merely provide background information related to the present disclosure and may not constitute prior art.

Oxy-fuel cutting torches, or gas cutting torches, generally employ oxygen and a fuel gas, such as acetylene or propane, by way of example, to cut a workpiece. More specifically, preheat oxygen and the fuel gas are mixed and ignited to provide heat to the workpiece, and then additional oxygen, commonly referred to as cutting oxygen, is added to react with the heated workpiece. This reaction of the cutting oxygen with the heated workpiece initiates sufficient heat and momentum of the gases to initiate a cutting process.

The cutting torch may be a premixed or a postmixed type torch. In a premixed torch, preheat oxygen and fuel gas are mixed within the torch head before being discharged for ignition. In a postmixed cutting torch, the preheat oxygen and fuel gas are discharged from the torch in unmixed streams. Turbulence in the discharged streams mixes the oxygen and fuel gas before ignition occurs. An advantage of the postmixed cutting torch is that postmixed cutting tips produce a longer heat zone than premixed tips, which permits the postmixed torches to operate farther from the work, decreasing the heat stress on the torch and increasing the service life of the tip.

With their inherent drawbacks, improved designs are desired in the field of premixed gas cutting torches. Moreover, ways in which to increase the lifetime of the premixed tip and provide a more compact tip design and thus reduce costs are also desirable.

SUMMARY

In one form, the present disclosure generally provides a method of directing gas flows in a gas torch. The gas torch includes a tip assembly. The tip assembly includes a tip and a mixer that is connected to the tip and secured to a torch head of the gas torch. The method includes: directing a flow of a first gas and a flow of a second gas to a mixer central gas passageway of the mixer; directing the flow of the mixed first and second gases from the mixer to an axial passageway of the tip; directing a flow of a third gas to an outer passageway of the tip; directing the flow of the third gas inwardly through at least one intermediate gas passageway; directing the flow of the third gas to a tip central gas passageway of the tip; and directing the flow of the mixed first and second gases and the flow of the third gas distally through a distal portion of the tip.

In another form of the present disclosure, a method of directing gas flows in a gas torch is provided. The gas torch includes a tip assembly. The tip assembly includes a tip and a mixer that is connected to the tip and secured to a torch head of the gas torch. The method includes: directing a first gas inwardly from outside the mixer through the mixer; directing a second gas distally in a central gas passageway of the mixer; mixing the first and second gases in the central gas passageway of the mixer; and directing a mixture of the first gas and the second gas distally through the tip.

In yet another form of the present disclosure, a method of directing gas flows in a gas torch is provided. The gas torch includes a tip assembly. The tip assembly includes a tip and a mixer that is connected to the tip and secured to a torch head of the gas torch. The method includes: directing a flow of a preheat oxygen and a flow of a fuel gas to a mixer central gas passageway of the mixer; directing a mixture of the preheat oxygen and the fuel gas to a distal end of the tip through an axial passageway of the tip that is offset from a tip central gas passageway; directing the mixture of the preheat oxygen and the fuel gas to a distal annular passageway at a distal portion of the tip; directing a flow of a cutting oxygen along an outer surface of the mixer to an outer passageway of a tip at a proximal portion of the tip; directing the flow of the cutting oxygen inwardly through at least one intermediate gas passageway to a tip central gas passageway of the tip; and directing the flow of the mixture of the preheat oxygen and the flow of the cutting oxygen distally through the distal portion of the tip.

Further areas of applicability will become apparent from the description provided herein. It should be understood that the description and specific examples are intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

DRAWINGS

The drawings described herein are for illustration purposes only and are not intended to limit the scope of the present disclosure in any way.

FIG. **1***a* is a partial cross-sectional view of a typical tip of a gas torch known in the art;

FIG. **1***b* is a perspective view of the tip of FIG. **1***a;*

FIG. **2** is a perspective view of a gas cutting torch constructed in accordance with the principles of the present disclosure;

FIG. **3***a* is a partial cross-sectional view of one form of a tip for use in a gas torch constructed in accordance with the principles of the present disclosure;

FIG. **3***b* is an alternate partial cross-sectional view of the tip of FIG. **3***a;*

FIG. **4** is cross-sectional view of another form of a tip for use in a gas torch, taken along a line through the intermediate passageways of the inner tip portion of the tip;

FIG. **5***a* is a partial cross-sectional view of another form of a tip for use in a gas torch constructed in accordance with further principles of the present disclosure;

FIG. **5***b* is a perspective view of the tip of FIG. **5***a;*

FIG. **6** is a perspective view of a tip assembly for use in a gas torch constructed in accordance with the principles of the present disclosure;

FIG. **7** is an exploded view of the tip assembly of FIG. **6**;

FIG. **8***a* is a partial cross-sectional view of the tip assembly of FIG. **6** taken along line **8***a*-**8***a*; and

FIG. **8***b* is a partial cross-sectional view of the tip assembly of FIG. **6** taken along line **8***b*-**8***b*.

DETAILED DESCRIPTION

The following description is merely exemplary in nature and is in no way intended to limit the present disclosure, its application, or uses. It should be understood that throughout the description and drawings, corresponding reference numerals indicate like or corresponding parts and features.

Referring to FIGS. **1***a*-*b*, a typical tip for use with a gas cutting torch is illustrated and generally indicated by reference numeral **10**. The tip **10** comprises a body **12** having a proximal end portion **14** which attaches to a torch head of the gas cutting torch (not shown) and a distal end portion **15** through which the gas exits to perform the cutting operation. The body **12** defines a central gas passageway **16** for the flow of cutting oxygen and a plurality of axial passageways **18** for the flow of preheat gas, e.g., premixed oxygen and fuel gas. Thus, cutting oxygen flows from a passage within the torch head of the gas cutting torch straight through the center, or central passageway **16**, of the tip **10**. Tips **10** having the traditional straight-through design are easy to manufacture, however, they are not designed for optimal cooling of the tip **10**.

Various forms of an improved tip for use with a gas cutting torch designed for enhanced cooling are disclosed herein and in U.S. patent application Ser. No. 12/849,028 entitled, "Gas Cutting Tip with Improved Flow Passage" to MacKenzie et al., the entire contents of which are incorporated by reference herein. Referring to FIG. **2**, a gas cutting torch in accordance with the teachings of the present disclosure is illustrated and generally indicated by reference numeral **20**. The gas cutting torch **20** includes a torch head **21** and a tip **22** secured to the torch head **21**, the tip **22** having an improved flow passage designed for enhanced cooling, various forms of which are described in further detail below and indicated by corresponding reference numerals increased by increments of 100.

FIGS. **3***a*-*b* illustrate one form of a tip **122** in accordance with the teachings of the present disclosure. The tip **122** includes a proximal end portion **114** which attaches to the torch head **21** of the gas cutting torch **20** and a distal end portion **115** through which the gas exits to perform the cutting operation. In this form, the tip **122** comprises an outer tip portion **124** having a proximal portion **126** and a distal portion **128**. The outer tip portion **124** defines an outer surface **130** and an inner surface **132** and further defines a central cavity **134** and a distal orifice **136**. An inner tip portion **140** is disposed within the central cavity **134** of the outer tip portion **124**. In one form, the outer tip portion **124** and the inner tip portion **140** are separate components. In another form, the outer tip portion **124** and the inner tip portion **140** are unitarily formed as a single piece by any suitable means in the art, such as, e.g., lost-wax casting.

The inner tip portion **140** has a proximal portion **142** and a distal portion **144** and defines an outer surface **146** and an inner surface **148**. The inner tip portion **140** further defines a central gas passageway **150** having a proximal end portion **152** generally occluded by a component of the gas cutting torch **20** extending to a distal end portion **154** in fluid communication with the distal orifice **136** of the outer tip portion **124**. Additionally, the inner tip portion **140** defines at least one intermediate gas passageway **156** extending from the outer surface **146** of the inner tip portion **140** to the central gas passageway **150** for the flow of at least one gas to provide improved cooling to the tip **122**, as described in further detail below. More specifically, in one form of the present disclosure, a plurality of intermediate gas passageways **156** extends between the outer surface **146** of the inner tip portion **140** and the central gas passageway **150**.

As shown in FIGS. **3***a*-*b*, the tip **122** defines a proximal annular gas passageway **160** and a distal annular gas passageway **162**. The proximal annular gas passageway **160** is disposed between the inner surface **132** of the proximal portion **126** of the outer tip portion **124** and the outer surface **146** of the proximal portion **142** of the inner tip portion **140**. The distal annular gas passageway **162** is disposed between the inner surface **132** of the distal portion **128** of the outer tip portion **124** and the outer surface **146** of the distal portion **144** of the inner tip portion **140**. In this form, the proximal and distal annular gas passageways **160**, **162** are generally not in fluid communication with one another due to the size and configuration of the inner tip portion **140** within the central cavity **134** of the outer tip portion **124**. As further illustrated in FIG. **3***b*, the inner tip portion **140** defines at least one offset axial passageway **166** that extends from within the proximal portion **142** of the inner tip portion **140** to the distal annular gas passageway **162**.

The tip **122** is attached to the torch head **21** of the gas cutting torch **20** by any suitable means known or contemplated in the art. For example, the torch head **21** may have external threads for receiving a threaded tip nut for connecting the tip **122** to the torch head **21**. Alternatively, in another form of the present disclosure, a tip seat may be secured to the torch head **21** and the tip **122** secured to the tip seat by way of a locking nut. The gas cutting torch **20** generally includes a plurality of internal gas supply tubes for the flow of preheat oxygen, fuel gas, and cutting oxygen and the torch head **21** generally includes a plurality of passages in fluid communication with the gas supply tubes and through which the preheat oxygen, fuel gas, and cutting oxygen flow and enter the tip **122**.

In operation, preheat gas, e.g., mixed preheat oxygen and fuel gas (i.e., acetylene, propane, liquid petroleum, or natural gas) flows from a passage within the torch head **21** (or from a mixer, as discussed in further detail with respect to FIGS. **6**-**8**) into the axial passageway **166** within the inner tip portion **140** of the tip **422**. The preheat gas flows through the axial passageway **166** into the distal annular gas passageway **162** and exits the distal portion **115** of the tip **122**. In this form, the proximal portion **152** of the central gas passageway **150** is occluded by a component of the gas cutting torch **20** (e.g., a mixer, as discussed in further detail with respect to FIGS. **6**-**8**).

Accordingly, cutting oxygen does not flow from the torch head **21** straight through the central passageway **150** of the tip **122** as in the traditional tip **10** of FIGS. **1***a*-*b*. Rather, cutting oxygen flows from a passage within the torch head **21** into the proximal annular gas passageway **160** and from the proximal annular gas passageway **160** into the central gas passageway **150** via the intermediate gas passageways **156**. The cutting oxygen thus flows in between the inner and outer tip portions **140**, **124** before entering the central gas passageway **150** via the intermediate passageways **156**. The geometry of the cutting oxygen flow passage, i.e., the extra surface area of the inner and outer tip portions **140**, **124** in contact with the cutting oxygen, results in an enhanced cooling effect. The enhanced cooling not only prolongs the lifetime of the consumable tip **122**, but allows for a smaller tip **122**, resulting in a more compact design due to the reduced distance between the distal orifice **136** and the point of entry of the cutting oxygen (i.e., the proximal end portion **114** of the tip **422**).

In FIG. **3***a*, the intermediate passageways **156** extend radially between the outer surface **146** of the inner tip portion **140** and the central gas passageway **150**. Alternatively, the intermediate passageways **156** may extend at an angle between the outer surface **146** of the inner tip portion **140** and the central gas passageway **150**. In another form of the present disclosure, as illustrated in FIG. **4**, the intermediate passageways **256** define a swirl configuration between the outer surface **246** of the inner tip portion **240** and the central gas passageway **250**.

In one form, the inner tip portion **140** includes at least one raised ridge or rib **170** extending along at least a portion of the outer surface **146** of the inner tip portion **140** and at least one flute disposed adjacent the rib **170**. FIG. **7** best illustrates an inner tip portion **440** of a tip **422** having a plurality of ribs **470** and flutes **468** extending along the outer surface **446** thereof to provide cooling as the gas passes through the flutes **468**. Alternatively, or in combination, the tip **122** may include at least one rib and at least one flute extending along at least a portion of the inner surface **132** of the outer tip portion **124**. Additionally, the tip **122** may include a dielectric spacer disposed between the outer tip portion **124** and the inner tip portion **140**. The dielectric spacer may include at least one rib and at least one flute extending along at least a portion of the inner surface of the dielectric spacer proximate the inner tip portion.

Further, the inner tip portion **140** is conductive and is adapted for electrical connection to an ignition system of the gas torch **20**. An ignition wire (not shown) from an ignition system extends through the tip **122** and is in electrical contact with the conductive inner tip portion **140** and thus generates the spark for ignition of the gas cutting torch **20**.

Referring to FIGS. **5***a-b*, another form of a tip for use with a gas cutting torch **20** in accordance with further teachings of the present disclosure is illustrated and generally indicated by reference numeral **322**. The tip **322** generally comprises a body **312** having a proximal end portion **314** which attaches to the torch head **21** and a distal end portion **315** through which the gas exits to perform the cutting operation. In this form, the body **312** defines at least one axial passageway **366** extending from the proximal end portion **314** to the distal end portion **315** for the flow of preheat gas and a central gas passageway **350** for the flow of cutting oxygen. Additionally, the body **312** defines at least one intermediate gas passageway **356** extending at an angle between the outer surface of the body **312** and the central gas passageway **350** for the flow of at least one gas to provide improved cooling to the tip **322**. As shown in FIG. **5***a*, the central gas passageway **350** is occluded near the proximal end portion **314** of the tip **322**.

In operation, the axial passageway **366** receives preheat gas from a passage in the torch head **21**. The central gas passageway **350** receives cutting oxygen via the intermediate gas passageways **356** in fluid communication with a cutting oxygen passage within the torch head **21**. Similar to the tip **122** of FIGS. **3***a-b*, the geometry of the cutting oxygen flow passage of the tip **322** provides enhanced cooling as a result of the extra surface area (i.e., the intermediate gas passageways **356**) in contact with the cutting oxygen.

Referring now to FIGS. **6**, **7**, and **8***a-b*, a tip assembly for use with a gas cutting torch in accordance with further teachings of the present disclosure is illustrated and generally indicated by reference numeral **408**. The tip assembly **408** comprises a tip **422** having a proximal end portion **414** which attaches to a torch head **421** and a distal end portion **415** through which gas exits to perform the cutting operation. The tip assembly **408** further comprises a mixer **480** attached to the proximal end portion **414** of the tip **422** and the torch head **421**.

The tip **422** includes an outer tip portion **424** having a proximal portion **426** and a distal portion **428**. The outer tip portion **424** defines an outer surface **430** and an inner surface **432** and further defines a central cavity **434** and a distal orifice **436**. An inner tip portion **440** is disposed within the central cavity **434** of the outer tip portion **424**. In FIG. **7**, the outer tip portion **424** and the inner tip portion **440** are separate components. However, the outer tip portion **424** and the inner tip portion **440** may be unitarily formed as a single piece by any suitable means in the art, such as, e.g., lost-wax casting.

The inner tip portion **440** has a proximal portion **442** and a distal portion **444** and defines an outer surface **446** and an inner surface **448**. The inner tip portion **440** defines a central gas passageway **450** having a proximal portion **452** generally occluded by a component of the gas cutting torch, i.e., the mixer **480**, as described in further detail below. The central gas passageway **450** extends from the proximal portion **452** to a distal portion **454** in fluid communication with the distal orifice **436** of the outer tip portion **424**. Additionally, the inner tip portion **440** defines at least one intermediate gas passageway **456** extending from the outer surface **446** of the inner tip portion **440** to the central gas passageway **450** for the flow of at least one gas to provide improved cooling to the tip **422**, as described in further detail below.

As best illustrated in FIGS. **8***a-b*, the tip **422** includes a proximal annular gas passageway **460** and a distal annular gas passageway **462**. The proximal annular gas passageway **460** is disposed between the inner surface **432** of the proximal portion **426** of the outer tip portion **424** and the outer surface **446** of the proximal portion **442** of the inner tip portion **440**. The distal annular gas passageway **462** is disposed between the inner surface **432** of the distal portion **428** of the outer tip portion **424** and the outer surface **446** of the distal portion **444** of the inner tip portion **440**. As further illustrated in FIG. **8***b*, the inner tip portion **440** defines at least one offset axial passageway **466** that extends from within the proximal portion **442** of the inner tip portion **440** to the distal annular gas passageway **462**.

The tip assembly **408** further includes a mixer **480** for mixing preheat oxygen and fuel gas to form a preheat gas mixture. As illustrated in FIGS. **8***a-b*, the mixer **480** includes a proximal end portion **482** adapted for removable connection to the torch head **421** and a distal end portion **484** adapted for connection to the tip **422**. In this form, the distal end portion **484** of the mixer **480** matingly fits within a proximal recess **438** of the inner tip portion **440**. The distal end portion **484** of the mixer **480** thus occludes the proximal portion **452** of the central gas passageway **450** of the inner tip portion **440**. The proximal portion **482** of the mixer **480** defines a connecting member **486** for removably connecting the mixer **480** to the torch head **421**. As best illustrated in FIGS. **8***a-b*, the connecting member **486** includes a detent that engages a recess formed within the torch head **421**. The connecting member **486** may alternatively include threads or any other suitable connection means known or contemplated in the art for removably connecting the mixer **480** to the torch head **421**.

The mixer **480** defines an outer surface **488** and an inner surface **490** and a plurality of internal gas passageways, including a central gas passageway **492**, a plurality of proximal gas passageways **494**, and a plurality of distal gas passageways **496**. In this form, the central gas passageway **492** extends from a proximal end **491** at the proximal end portion **482** of the mixer **480** to a distal end **493** proximate the distal end portion **484** of the mixer. The plurality of proximal gas passageways **494** extend from the outer surface **488** of the proximal end portion **482** of the mixer **480** to the central gas passageway **492**. In FIGS. **8***a-b*, the proximal gas passageways **494** extend radially between the outer surface **488** of the mixer **480** and the central gas passageway **492**. In another form, the proximal gas passageways **494** may extend at an angle between the outer surface **488** of the mixer **480** and the central gas passageway **492** or in a spiral configuration similar to the intermediate passageways of the tip of FIGS. **5***a-b* and **4**, respectively.

The plurality of distal gas passageways **496** extend from the distal end **493** of the central gas passageway **492** to the outer surface **488** of the distal end portion **484** of the mixer **480**. In this form, the distal gas passageways **496** extend at an angle between the central gas passageway **492** and the outer surface **488** of the distal end portion **484** of the mixer **480**.

As illustrated in FIGS. **6-8**, the tip assembly **408** further comprises a locking ring **498** for connecting the tip **422** and the mixer **480** to the torch head **421** and a spacer **499** disposed between the locking ring **498** and the outer surface **430** of the proximal portion **426** of the outer tip portion **424**.

The torch head **421** generally includes a plurality of passages in fluid communication with gas supply tubes within the gas cutting torch **20**. As illustrated in FIGS. **8***a-b*, the torch head **421** includes a cutting oxygen inlet bore **472**, a preheat oxygen inlet bore **474**, and a fuel gas inlet bore **476** for receiving cutting oxygen, preheat oxygen, and fuel gas from respective supply tubes within the gas cutting torch **20**. The torch head **421** defines at least one cutting oxygen passage **473** extending from the cutting oxygen inlet bore **472**, a preheat oxygen passage **475** extending from the preheat oxygen inlet bore **474**, and a fuel gas passage **477** extending from the fuel gas inlet bore **476**. It is noted that the positioning of the preheat oxygen inlet bore **474** and corresponding preheat oxygen passage **475** and the fuel gas inlet bore **476** and corresponding fuel gas passage **477** may be switched, i.e., reference numerals **474**, **475** and **476**, **477** may designate either the preheat oxygen inlet bore and passage or the fuel gas inlet bore and passage.

The tip **422** and the mixer **480** are connected to the torch head **421** such that the cutting oxygen passage **473** and the proximal annular passageway **460** of the tip **422** are in fluid communication; and such that one of the preheat oxygen passage **475** and the fuel gas passage **477** is in fluid communication with the central passageway **492** of the mixer **480** and the other one of the preheat oxygen passage **475** and the fuel gas passage **477** is in fluid communication with the proximal gas passageways **494** of the mixer. In FIG. **8***a*, the preheat oxygen passage **475** and the central gas passageway **492** of the mixer **480** are in fluid communication via the recess **423** formed within the torch head **421**, and the fuel gas passage **477** and the proximal gas passageways **494** of the mixer **480** are in fluid communication.

In operation, preheat oxygen and fuel gas (i.e., acetylene, propane, liquid petroleum, or natural gas) are mixed within the mixer **480** to form preheat gas. More specifically, preheat oxygen flows from an internal preheat oxygen supply tube within the gas torch **20** into the preheat oxygen passage **475** via the preheat oxygen inlet bore **474**. The preheat oxygen flows through the preheat oxygen passage **475** and the recess **423** formed within the torch head **421** and enters the proximal end **491** of the central gas passageway **492** of the mixer **480**. The fuel gas flows from an internal fuel gas supply tube within the gas torch **20** into the fuel gas passage **477** via the fuel gas inlet bore **476**. The fuel gas flows through the fuel gas passage **477** within the torch head **421** and enters the central gas passageway **492** of the mixer **480** via the plurality of proximal gas passageways **494**. The preheat oxygen and the fuel gas mix within the mixer **480** as they flow together through the central gas passageway **492**. The mixed preheat gas then flows from the mixer **480** to the at least one axial gas passageway **466** via the angled distal gas passageways **496**. The preheat gas flows through the axial passageway **466** into the distal annular gas passageway **462** and exits the distal portion **415** of the tip **422** for the discharge of preheat gas from the torch.

Additionally, cutting oxygen flows from an internal cutting oxygen supply tube within the gas torch **20** into the cutting oxygen passage **473** via the cutting oxygen inlet bore **472**. As illustrated in FIGS. **8***a-b*, the proximal portion **452** of the central gas passageway **450** of the inner tip portion **440** of the tip **422** is occluded by the distal end portion **484** of the mixer **480**. Accordingly, cutting oxygen does not flow from the torch head **421** straight through the central gas passageway **450** of the tip **422** as in the traditional tip **10** of FIGS. **1***a-b*. Rather, cutting oxygen flows from the cutting oxygen passage **473** within the torch head **421** into the proximal annular gas passageway **460** of the tip **422** and from the proximal annular gas passageway **460** into the central gas passageway **450** via the intermediate gas passageways **456**. The cutting oxygen thus flows in between the inner and outer tip portions **440**, **424** before entering the central gas passageway **450** via the intermediate passageways **456**. The cutting oxygen then flows distally through the central gas passageway **450** and exits the distal portion **415** of the tip **422** via the distal orifice **436** for the discharge of cutting oxygen from the gas torch **20**.

Accordingly, FIGS. **6**, **7**, and **8***a-b* illustrate a tip assembly **408** including a consumable tip **422** having an improved flow passage geometry for enhanced cooling of the tip **422** due to the extra surface area of the inner and outer tip portions **440**, **424** in contact with the cutting oxygen. The enhanced cooling not only prolongs the lifetime of the consumable tip **422**, but allows for a smaller tip **422**, resulting in a more compact design due to the reduced distance between the distal orifice **436** and the point of entry of the cutting oxygen (i.e., the proximal end portion **414** of the tip **422**). More specifically, a tip having a traditional flow passage similar to that shown in FIGS. **1***a-b* typically has a length of about 2.5 inches whereas a tip **422** having an improved flow passage in accordance with the teachings of the present disclosure, in one example, has a length of about 1.5 inches. With a reduction in tip size follows a reduction in material, e.g., copper, and thus a reduction in cost.

Additionally, the mixer **480** of the tip assembly **408** defines a distended length and allows for a tip **422** having a reduced length. Thus, the mixer **480** and the tip **422** having an improved flow passage provide a premixed tip having a more compact design. Further, the enhanced cooling effect of the improved flow passage of the premixed tip **422** of the present disclosure has a similar effect as the longer heat zone in postmixed tips, i.e., decreases the heat stress on the torch and increases the life of the consumable tip.

The present disclosure is merely exemplary in nature and, thus, variations that do not depart from the gist of the disclosure are intended to be within the scope of the present disclosure. Such variations are not to be regarded as a departure from the spirit and scope of the present disclosure.

What is claimed is:

1. A method of directing gas flows in a gas torch, the gas torch comprising a tip assembly, wherein the tip assembly comprises a tip and a mixer, the mixer being connected to the tip and secured to a torch head of the gas torch, the method comprising:

directing a flow of a first gas and a flow of a second gas to a mixer central gas passageway of the mixer;

directing the flow of the mixed first and second gases from the mixer to an axial passageway of the tip;

directing a flow of a third gas to an outer passageway of the tip;

directing the flow of the third gas inwardly through at least one intermediate gas passageway;

directing the flow of the third gas to a tip central gas passageway of the tip; and

directing the flow of the mixed first and second gases and the flow of the third gas distally through a distal portion of the tip.

2. The method according to claim 1, wherein the flow of the first gas comprises preheat oxygen, wherein the flow of the second gas comprises fuel gas, and wherein the flow of the third gas comprises cutting oxygen.

3. The method according to claim 1, wherein the flow of the third gas is directed radially through the at least one intermediate gas passageway.

4. The method according to claim 1, wherein the flow of the third gas is directed at an angle through the at least one intermediate gas passageway.

5. The method according to claim 1, wherein the flow of the third gas is swirled through the at least one intermediate gas passageway.

6. The method according to claim 1, wherein the flow of one of the first and second gases is directed from a passage within the torch head through at least one proximal gas passageway of the mixer.

7. The method according to claim 1, wherein the flow of the mixed first and second gases is directed from the mixer central gas passageway through at least one distal gas passageway of the mixer.

8. The method according to claim 7, wherein the flow of the mixed first and second gases is directed at an angle through the at least one distal gas passageway.

9. A method of directing gas flows in a gas torch, the gas torch comprising a tip assembly, wherein the tip assembly comprises a tip and a mixer connected to the tip, the method comprising:

directing a first gas inwardly from outside the mixer through the mixer;

directing a second gas distally in a central gas passageway of the mixer;

mixing the first and second gases in the central gas passageway of the mixer; and

directing a mixture of the first gas and the second gas distally through the tip.

10. The method according to claim 9, further comprising directing the mixture of the first and second gases from the central gas passageway of the mixer to an axial gas passageway of the tip.

11. The method according to claim 10, wherein the axial gas passageway is offset from a central gas passageway of the tip.

12. The method according to claim 10, further comprising directing the mixture of the first and second gases from the axial gas passageway to a distal annular gas passageway of the tip.

13. The method according to claim 12, wherein the central gas passageway of the mixer is in fluid communication with the distal annular gas passageway through the axial passageway.

14. The method according to claim 13, wherein the mixer further includes a plurality of distal passageways in fluid communication with the central gas passageway of the mixer and the axial gas passageway of the tip.

15. The method according to claim 9, further comprising directing a third gas along an outer surface of the mixer before directing the third gas to a tip central gas passageway of the tip.

16. The method according to claim 9, further comprising directing a third gas distally along an outer surface of an inner tip and inwardly through the inner tip into a tip central gas passageway of the tip.

17. The method according to claim 9, further comprising directing a third gas inwardly through an intermediate gas passageway formed in an inner tip.

18. The method according to claim 17, wherein the intermediate passageway extends radially from an outer surface of the tip to a tip central gas passageway.

19. The method according to claim 9, wherein the first gas comprises preheat oxygen, the second gas comprises fuel gas, and the third gas comprises cutting oxygen.

20. A method of directing gas flows in a gas torch, the gas torch comprising a tip assembly wherein the tip assembly comprises a tip and a mixer connected to the tip, the method comprising:

directing a flow of a preheat oxygen and a flow of a fuel gas to a mixer central gas passageway of the mixer;

directing a mixture of the preheat oxygen and the fuel gas to a distal end of the tip through an axial passageway of the tip that is offset from a tip central gas passageway;

directing the mixture of the preheat oxygen and the fuel gas to a distal annular passageway at a distal portion of the tip;

directing a flow of a cutting oxygen along an outer surface of the mixer to an outer passageway of a tip at a proximal portion of the tip;

directing the flow of the cutting oxygen inwardly through at least one intermediate gas passageway to a tip central gas passageway of the tip; and

directing the flow of the mixture of the preheat oxygen and the flow of the cutting oxygen distally through the distal portion of the tip.

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